

Accuracy Characteristics for Final Delivery Scenario Hours 1100-1600 Interfacility

1 Introduction

This document contains scenario characteristics for hours 1100 to 1600 GMT recorded on May 26, 1999 at Memphis ARTCC and cover either the ZME or ZID airspace. Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, flight plan adherence, interfacility traffic flow and deviations in weather forecasts. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the May 20, 1999 ACES chart cycle. Information gathered from running URET PRE, accessing the ZME Center Internet site and local knowledge.

Metric	Definitions	Count
Center Area	Approximate Square Miles	120000
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 1: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	139	91
$5 \leq d < 10$	188	116
$10 \leq d < 15$	235	143
$15 \leq d < 23$	465	270
$23 \leq d < 30$	376	242
Total	1403	862

Table 2: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	139	87
$5 \leq d < 10$	188	113
$10 \leq d < 15$	235	136
$15 \leq d < 24$	518	284
$24 \leq d < 30$	323	201
Total	1403	821

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

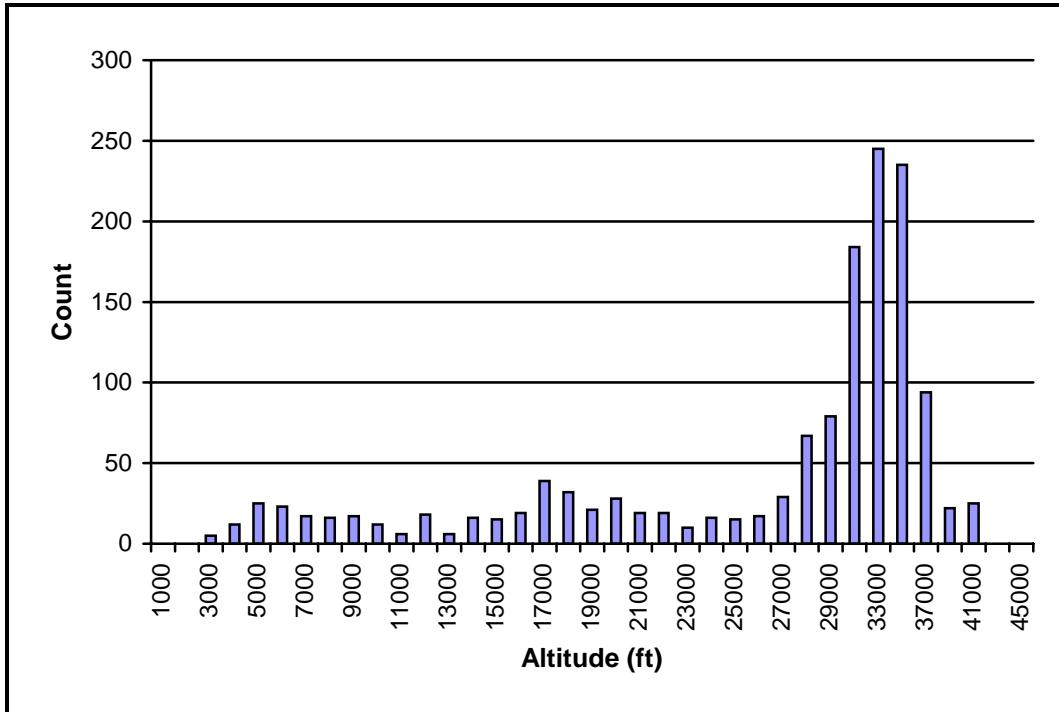


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 3: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	119	119	56	24	318
Descend-Descend	37	6	6	9	58
Climb-Climb	26	5	4	5	40
Cruise-Climb	144	84	79	111	418
Cruise-Descend	151	84	82	112	429
Climb-Descend	34	21	23	49	127
Unknown	9	4	0	0	13
Total	520	323	250	310	1403

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 4: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	2293	1993
$d = 0^2$	30	25
$0 < d < 7$	786	632
$7 \leq d < 9$	221	171
$9 \leq d < 11$	180	148
$11 \leq d < 16$	521	403
$16 \leq d < 30$	1845	1452
Total	5876	4824

Table 5: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	2293	1955
$d = 0^4$	30	25
$0 < d < 8$	904	713
$8 \leq d < 11$	283	218
$11 \leq d < 13$	178	131
$13 \leq d < 19$	722	564
$19 \leq d < 30$	1466	1124
Total	5876	4730

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

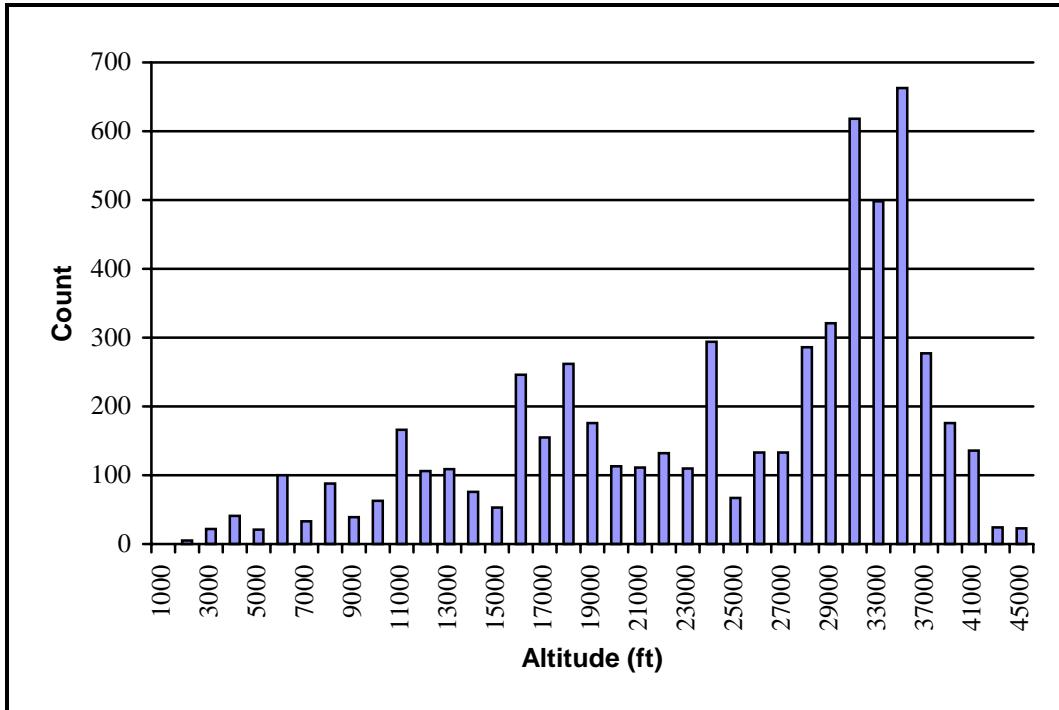


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 6: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	18	74	113	205
Cruise	122	601	715	1438
Descend	22	63	69	154
Total	162	738	897	1797

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	177	0	0	177
Cruise	1	0	0	1
Descend	20	0	0	20
Total	198	0	0	198

Table 8: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	59
Cruise	208
Descend	31
Total	298

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

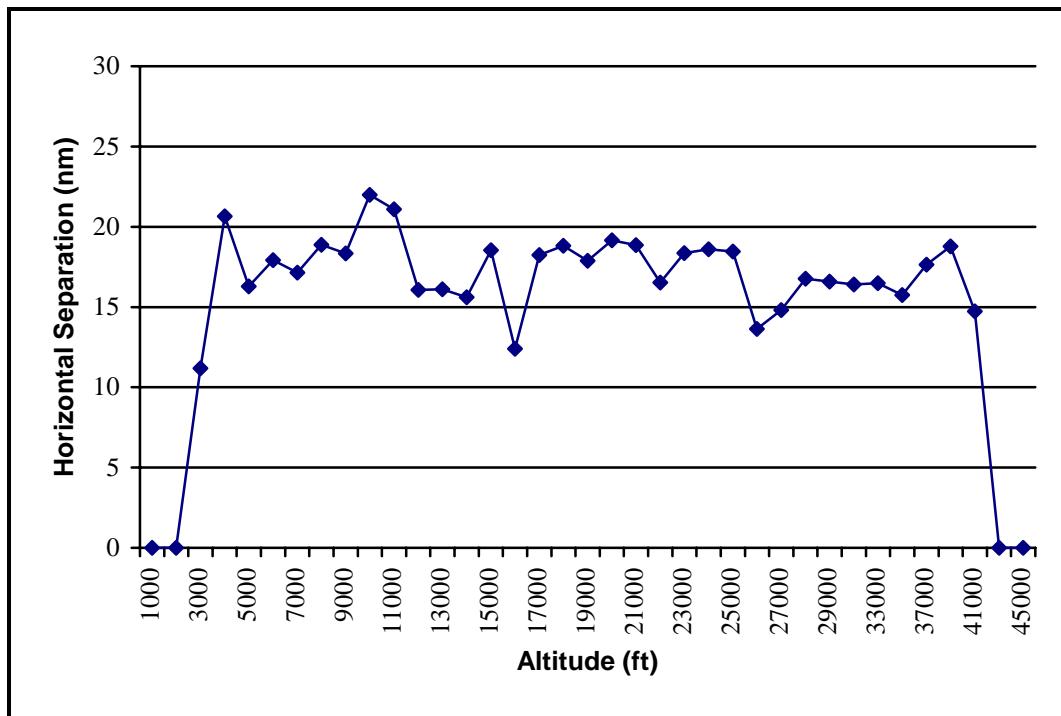


Figure 3: Average Horizontal Separation by Altitude for All Hours

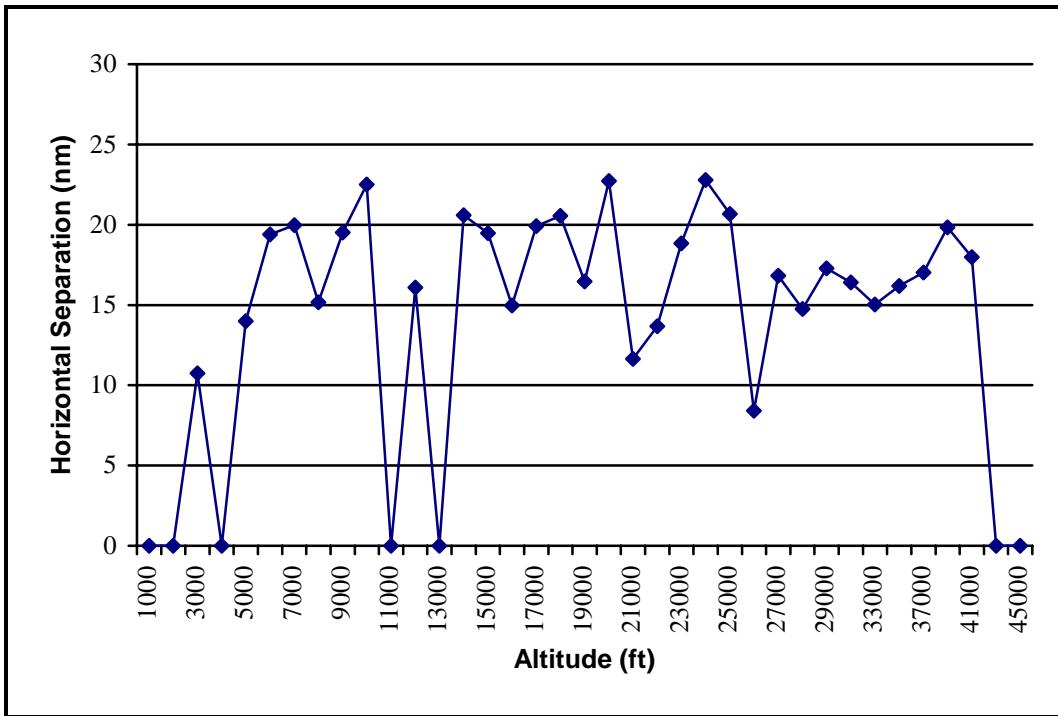


Figure 4: Average Horizontal Separation by Altitude for Hour 1

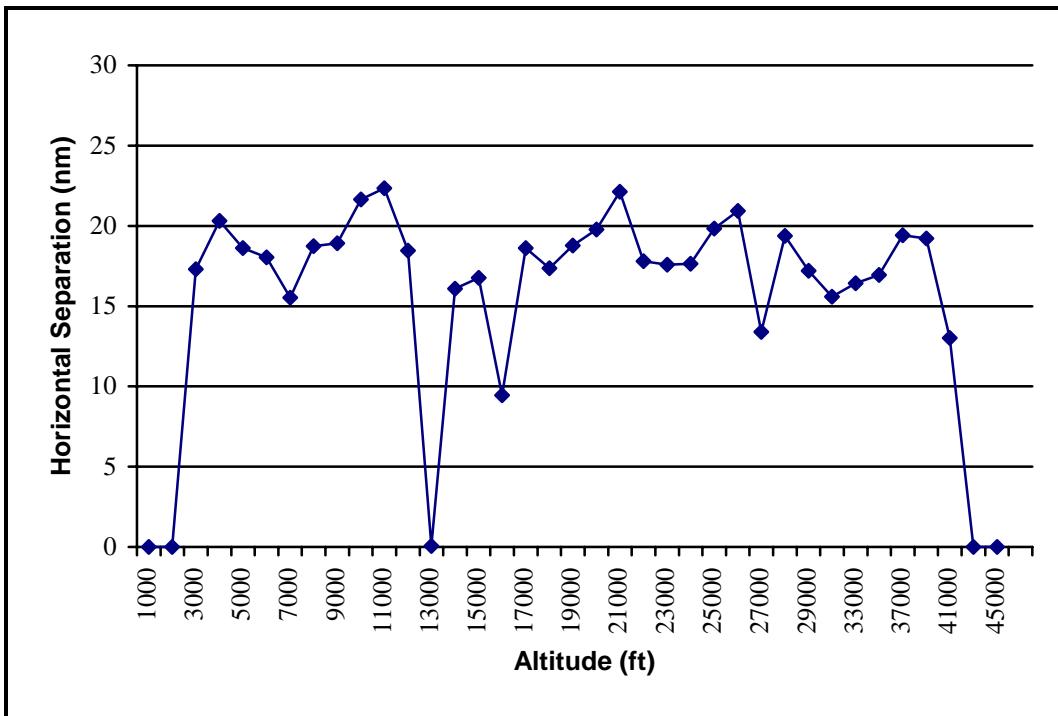


Figure 5: Average Horizontal Separation by Altitude for Hour 2

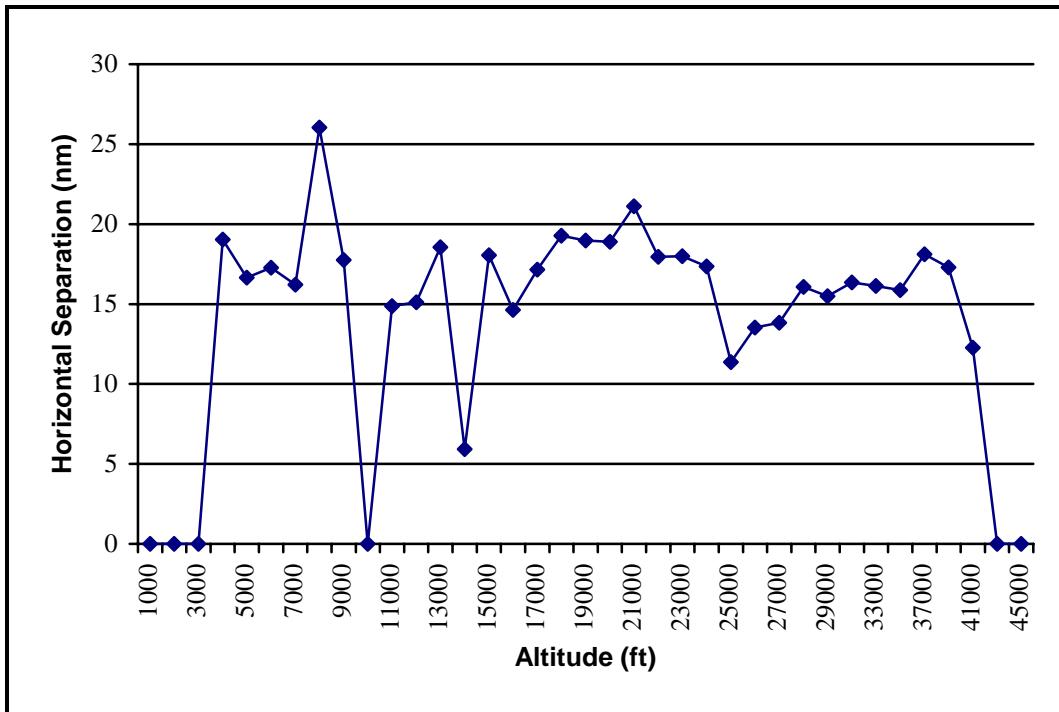


Figure 6: Average Horizontal Separation by Altitude for Hour 3

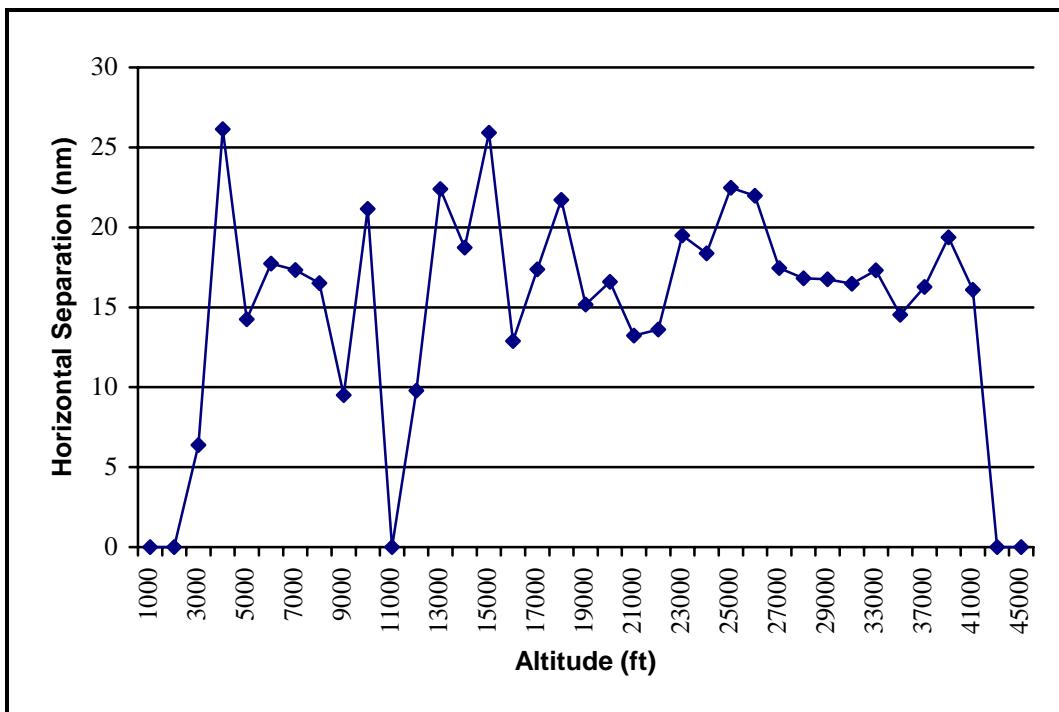


Figure 7: Average Horizontal Separation by Altitude for Hour 4

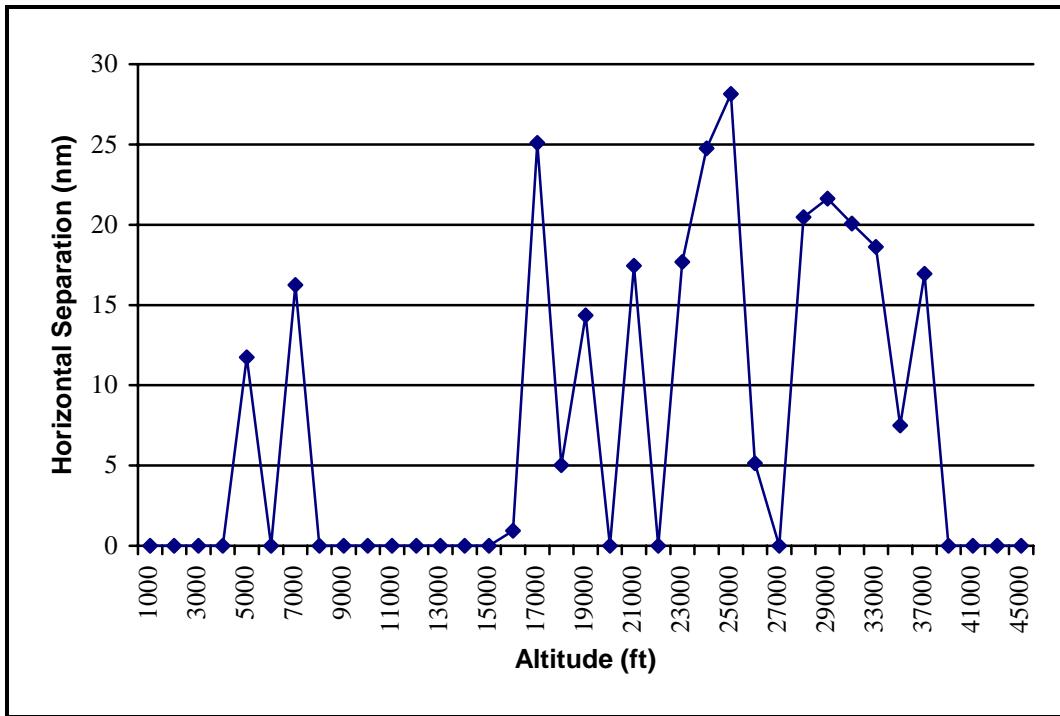


Figure 8: Average Horizontal Separation by Altitude for Hour 5

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 9: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
182.387	82.450	273	0

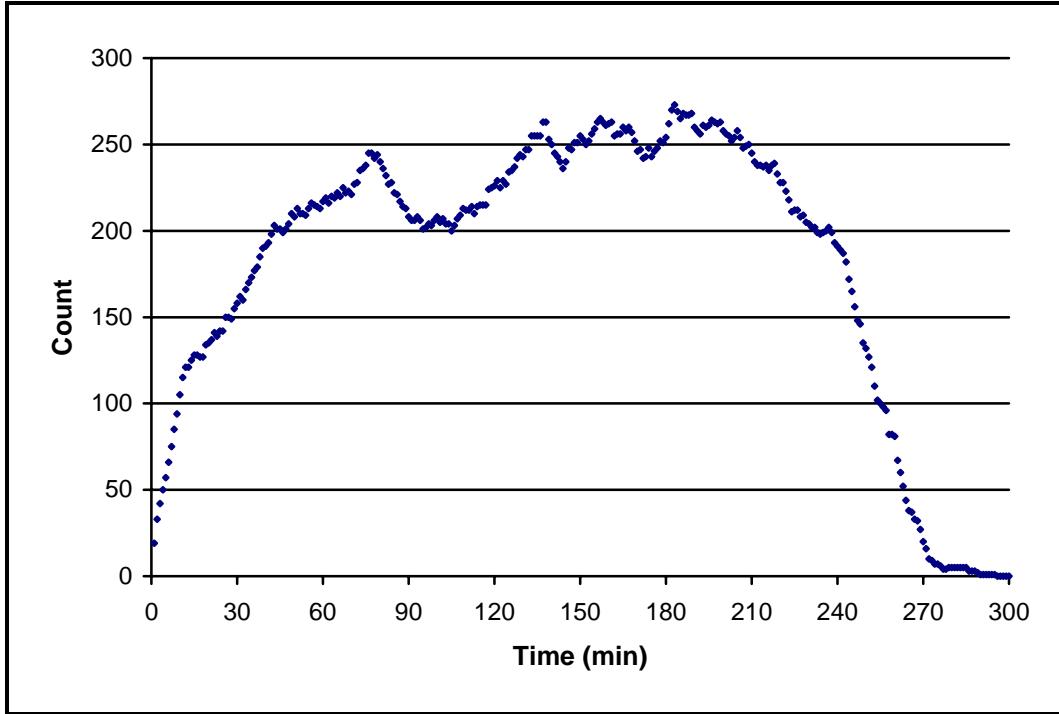


Figure 9: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 10: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	1.997	2.257	2.073	2.547	2.321
Average Time in Center (sec)	1338.210	1247.044	1578.257	1830.698	1562.077
Average Time in Sector (sec)	654.900	539.376	728.628	709.395	660.058
Percentage by Flight Type	21.800	24.400	7.300	46.400	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

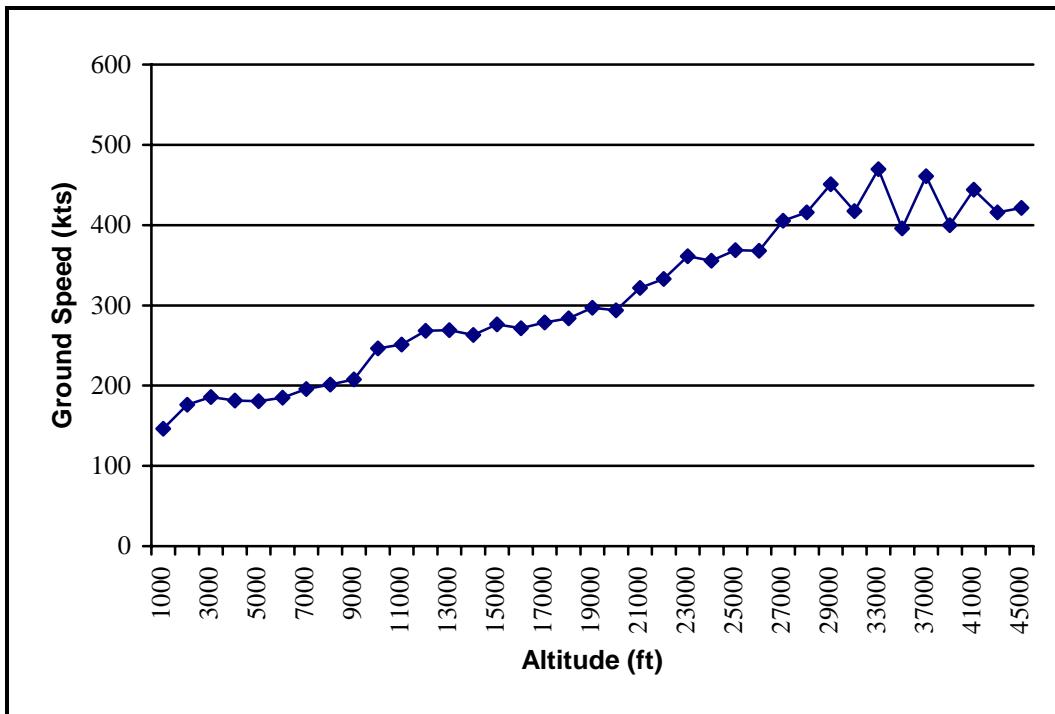


Figure 10: Average Ground Speed by Altitude for All Hours

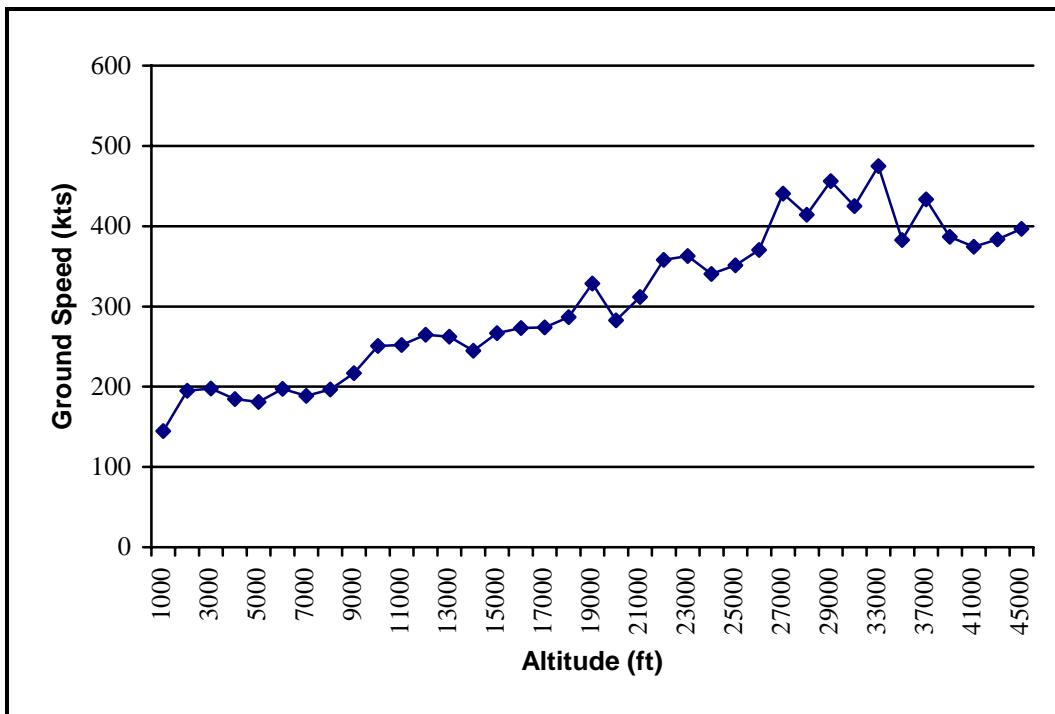


Figure 11: Average Ground Speed by Altitude for Hour 1

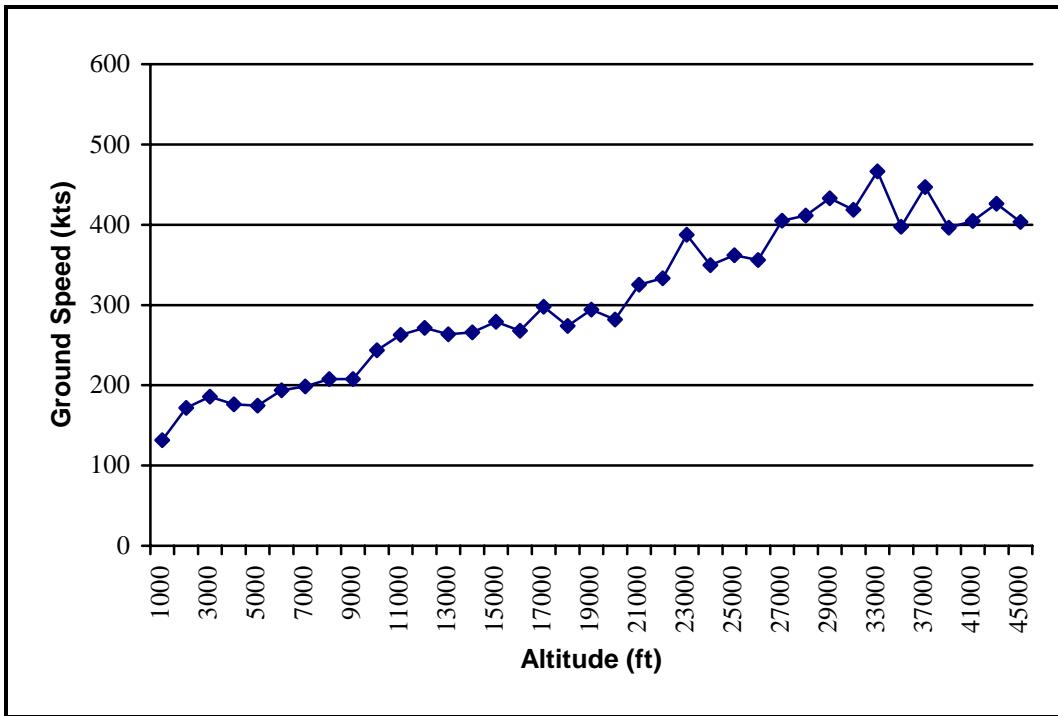


Figure 12: Average Ground Speed by Altitude for Hour 2

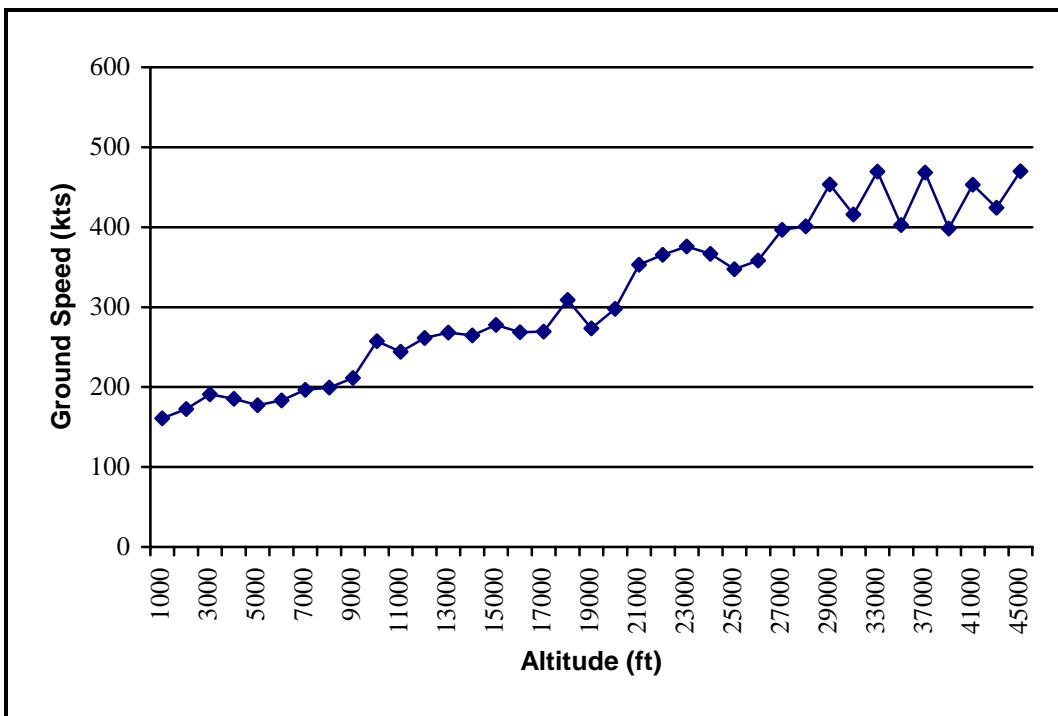


Figure 13: Average Ground Speed by Altitude for Hour 3

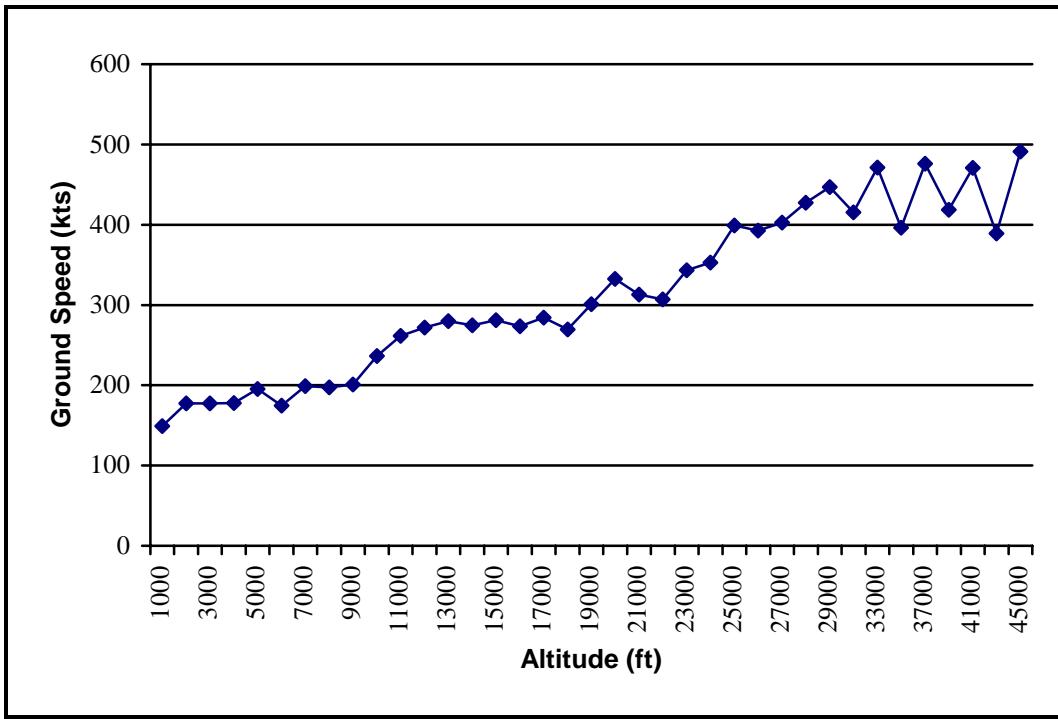


Figure 14: Average Ground Speed by Altitude for Hour 4

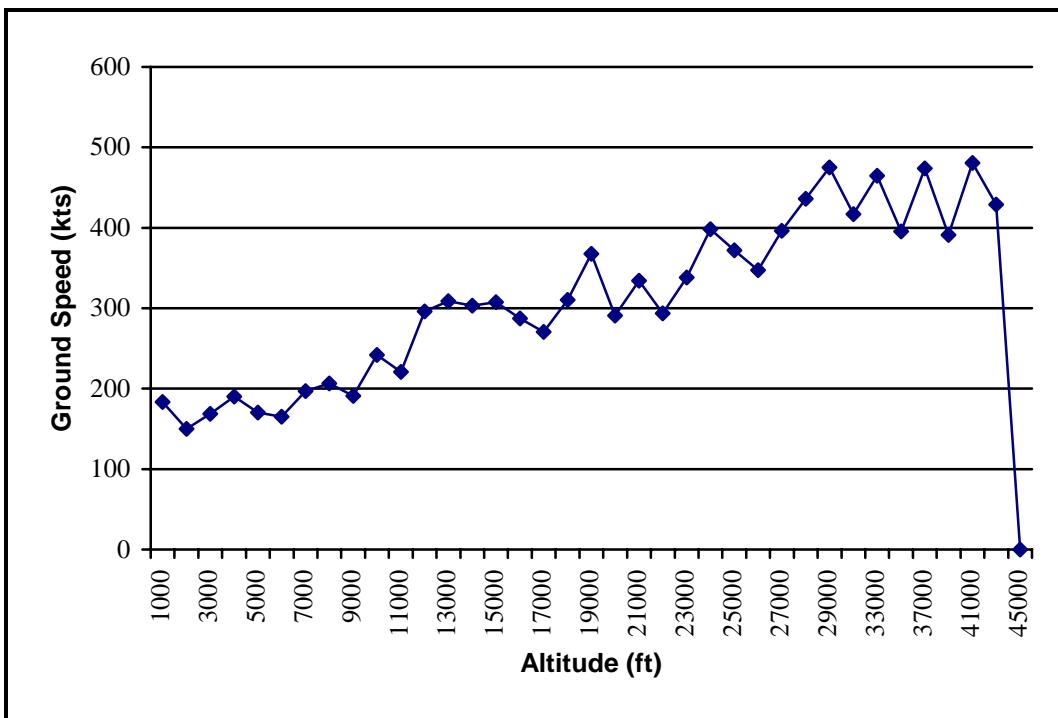


Figure 15: Average Ground Speed by Altitude for Hour 5

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

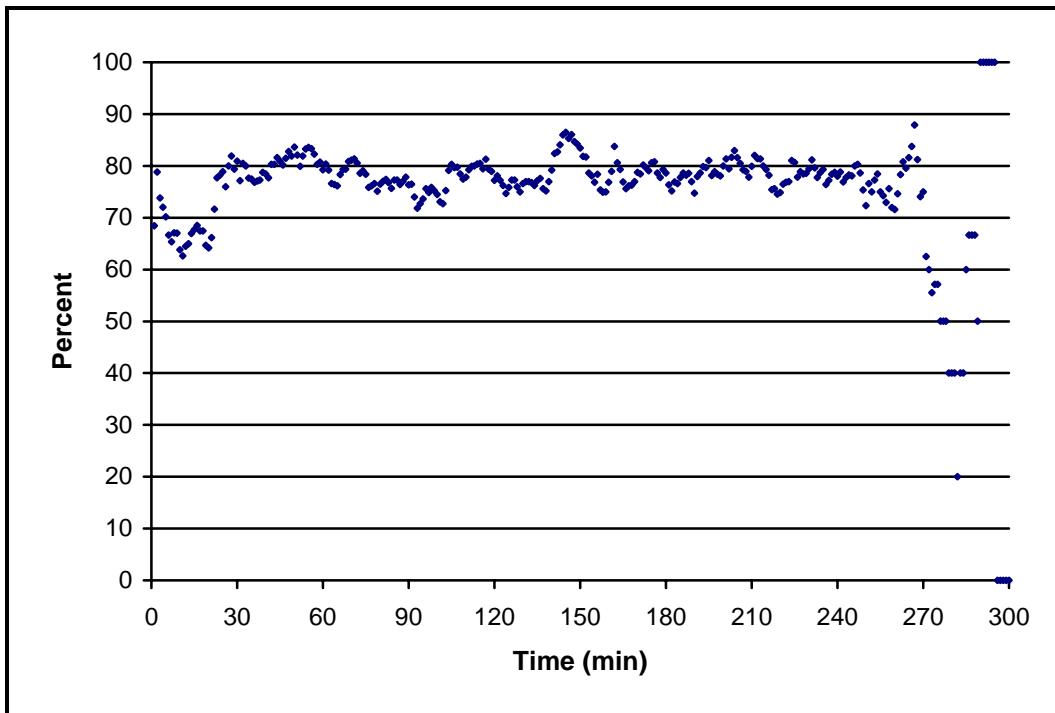


Figure 16: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 11: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
1079	2.904	1.214	10	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 12: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
801	1.985	1.281	9	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 13: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	8546	1740	10286
DES	9263	1775	11038
LEV	3258	1946	5204
Total	21067	5461	26528

Table 14: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	32.215	6.559	38.774
DES	34.918	6.691	41.609
LEV	12.281	7.336	19.617
Margin (%)	79.414	20.586	100.000

7 Aircraft Distributions

This section provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 15: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	1009	67.177
P	196	13.049
T	295	19.640
Unknown	2	0.133
Total	1502	100.000

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

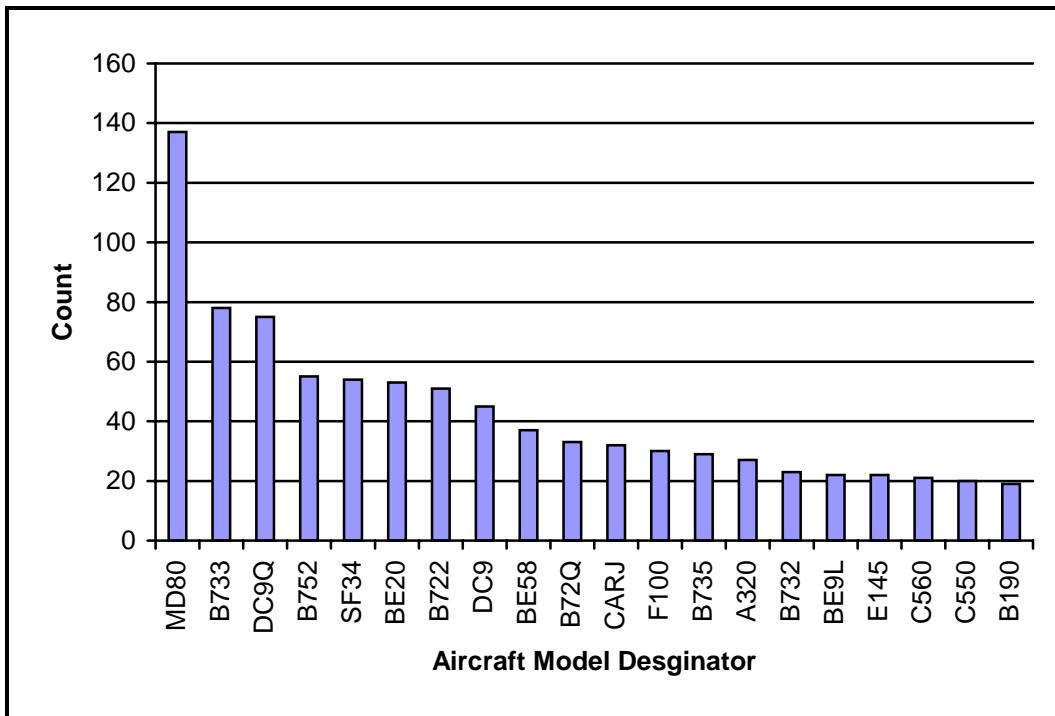


Figure 17: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 16: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
A	438	29.161
I	376	25.033
G	276	18.375
E	170	11.318
F	157	10.453
R	60	3.995
U	20	1.332
P	4	0.266
W	1	0.067
Total	1502	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 17: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	947	63.049
General Aviation	518	34.487
Other ⁷	37	2.463
Total	1502	100.000

⁷ Includes military and aircraft with unrecognized designators

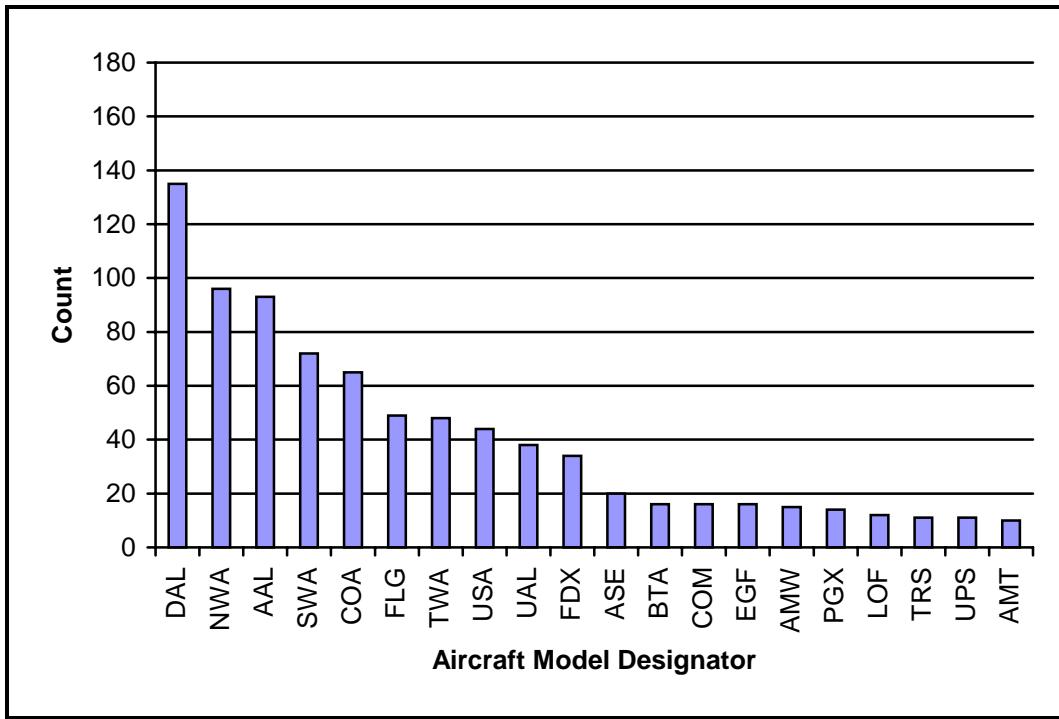


Figure 18: Count by Top Twenty Air Carriers

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 18: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	58	34	11	16.813	4.173
18000	37	47	13	20.315	5.407
33000	77	58	13	24.935	6.794
45000	38	85	14	25.916	12.248
Total	210				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 19: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	673	30200	316	4155.677	3670.420
45000	240	25000	509	4701.575	3245.170
Total	913				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

9 Interfacility Traffic Flow

This section corresponds to Section 3.6 of Reference[1]. Table 20 duplicates Table 3.6-1 in reference and provides definitions for cells in Tables 21 and 22.

Table 20: Matrix of Traffic Sources in Scenario

Input - Flights into ZME	Output - Flights from ZME
Starts in ZID	Ends in ZID
Starts in ZME	Ends in ZME
Starts in Other Centers	Ends in Other Centers

Table 21: Statistics on Flights into ZME Airspace per minute

Input Flights	Average	Standard Deviation	Maximum Count	Minimum Count
From ZID	32.613	15.397	51	0
From ZME	58.423	25.121	85	0
From Other	91.350	44.783	148	0

Table 22: Statistics on Flights from ZME Airspace per minute

Output Flights	Average	Standard Deviation	Maximum Count	Minimum Count
To ZID	19.540	12.673	44	0
To ZME	63.247	26.380	104	0
To Other	99.600	51.394	166	0

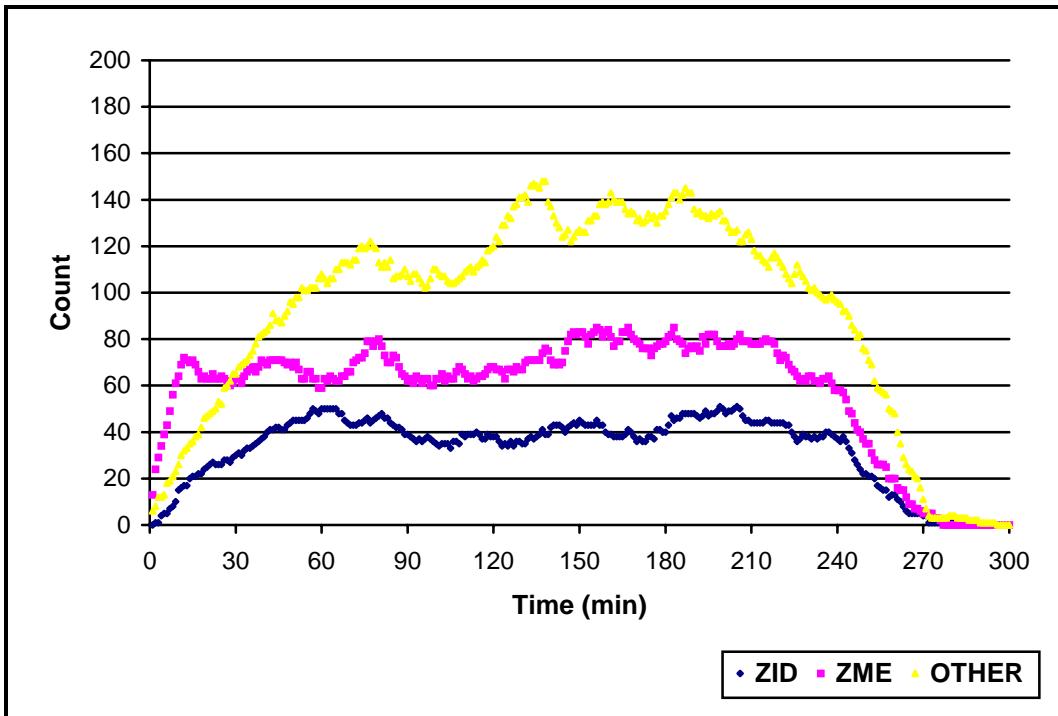


Figure 19: Flights into ZME from Legend Centers

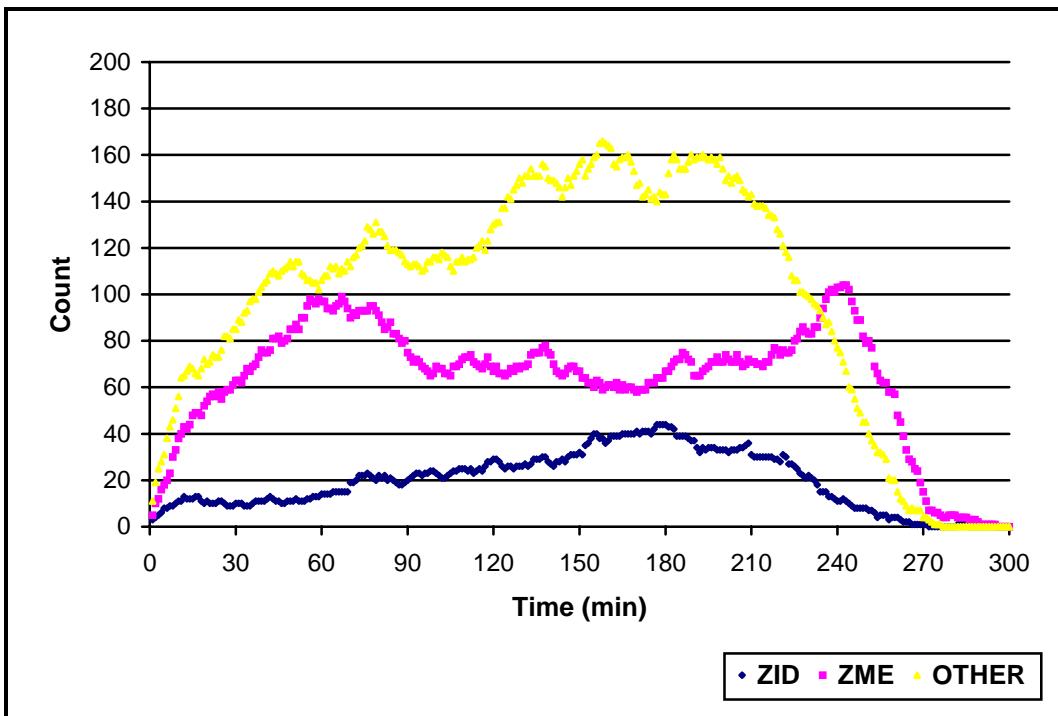


Figure 20: Flights from ZME to Legend Centers

10 Weather Variations

This section corresponds to Section 3.7 of Reference[1]. See the following document,

Kelly, Betty A., *User Request Evaluation Tool Core Capability Limited Deployment Accuracy Scenario Weather Forecast Deviation Study*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 23: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	5	11.186	4.764
4000	12	20.646	7.359
5000	25	16.288	8.165
6000	23	17.911	7.917
7000	17	17.137	7.962
8000	16	18.878	5.647
9000	17	18.334	6.164
10000	12	21.989	5.041
11000	6	21.098	5.574
12000	18	16.074	8.657
13000	6	16.111	10.444
14000	16	15.615	8.577
15000	15	18.529	8.440
16000	19	12.396	8.547
17000	39	18.247	7.795
18000	32	18.820	7.451
19000	21	17.874	8.074
20000	28	19.159	7.094
21000	19	18.857	6.720
22000	19	16.525	7.541
23000	10	18.350	5.357
24000	16	18.597	6.708
25000	15	18.467	7.829
26000	17	13.636	8.583
27000	29	14.811	8.906
28000	67	16.774	7.984
29000	79	16.582	7.058
31000	184	16.404	7.955
33000	245	16.490	8.238
35000	235	15.742	8.140
37000	94	17.651	7.903
39000	22	18.772	7.244
41000	25	14.723	9.779
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	1403		

Table 24: Statistics on Aircraft Encounters by Altitude for Hour 1

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	3	10.748	3.851
4000	0	0.000	0.000
5000	3	13.995	2.042
6000	3	19.390	12.956
7000	4	19.981	8.105
8000	3	15.163	7.190
9000	7	19.506	7.833
10000	6	22.496	6.366
11000	0	0.000	0.000
12000	8	16.093	6.107
13000	0	0.000	0.000
14000	5	20.594	4.106
15000	4	19.484	7.409
16000	7	14.975	9.318
17000	7	19.917	8.792
18000	1	20.558	0.000
19000	2	16.475	13.328
20000	3	22.721	3.013
21000	1	11.640	0.000
22000	2	13.667	3.775
23000	2	18.834	5.087
24000	1	22.778	0.000
25000	3	20.665	3.063
26000	4	8.406	6.348
27000	4	16.831	8.240
28000	13	14.758	8.920
29000	10	17.290	8.417
31000	18	16.414	7.278
33000	34	15.021	8.929
35000	49	16.179	8.861
37000	13	17.028	7.526
39000	5	19.838	5.479
41000	1	17.977	0.000
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	226		

Table 25: Statistics on Aircraft Encounters by Altitude for Hour 2

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	17.305	0.000
4000	4	20.309	7.784
5000	8	18.620	8.577
6000	8	18.031	6.856
7000	4	15.522	9.525
8000	6	18.736	3.850
9000	5	18.916	5.261
10000	4	21.641	1.661
11000	5	22.344	5.214
12000	6	18.465	10.124
13000	1	0.064	0.000
14000	3	16.082	6.814
15000	5	16.772	10.550
16000	4	9.446	5.620
17000	9	18.616	9.126
18000	11	17.361	9.171
19000	10	18.770	7.607
20000	11	19.774	7.900
21000	9	22.134	6.662
22000	8	17.801	6.851
23000	2	17.581	5.825
24000	3	17.650	7.620
25000	6	19.827	8.450
26000	3	20.923	4.349
27000	12	13.394	8.827
28000	11	19.366	8.120
29000	15	17.208	4.378
31000	24	15.596	8.526
33000	49	16.416	8.969
35000	62	16.938	8.141
37000	14	19.410	7.196
39000	6	19.221	8.356
41000	8	13.010	10.782
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	337		

Table 26: Statistics on Aircraft Encounters by Altitude for Hour 3

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	6	19.040	8.200
5000	8	16.660	6.938
6000	7	17.275	9.488
7000	5	16.216	9.859
8000	3	26.031	1.865
9000	4	17.761	3.580
10000	0	0.000	0.000
11000	1	14.864	0.000
12000	2	15.117	18.615
13000	4	18.553	8.654
14000	4	5.929	5.323
15000	5	18.044	8.840
16000	1	14.620	0.000
17000	12	17.158	6.352
18000	11	19.266	6.196
19000	5	18.967	8.958
20000	8	18.899	5.010
21000	2	21.122	7.750
22000	5	17.953	8.117
23000	3	17.998	8.573
24000	5	17.359	8.116
25000	4	11.361	6.957
26000	4	13.524	9.727
27000	7	13.829	8.990
28000	20	16.069	7.981
29000	28	15.490	7.422
31000	69	16.354	8.344
33000	76	16.126	8.247
35000	52	15.865	7.950
37000	41	18.110	8.720
39000	7	17.286	8.811
41000	3	12.261	1.754
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	412		

Table 27: Statistics on Aircraft Encounters by Altitude for Hour 4

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	6.381	0.000
4000	2	26.139	1.206
5000	5	14.250	12.629
6000	5	17.723	6.411
7000	3	17.331	7.356
8000	4	16.511	5.049
9000	1	9.506	0.000
10000	2	21.164	8.078
11000	0	0.000	0.000
12000	2	9.778	6.205
13000	1	22.387	0.000
14000	4	18.726	10.321
15000	1	25.917	0.000
16000	6	12.892	9.797
17000	10	17.367	8.469
18000	8	21.720	5.475
19000	3	15.171	10.769
20000	6	16.596	9.576
21000	4	13.222	4.158
22000	4	13.619	10.707
23000	2	19.495	6.806
24000	6	18.378	6.769
25000	1	22.470	0.000
26000	3	21.973	2.782
27000	6	17.444	10.829
28000	20	16.808	7.776
29000	24	16.748	7.602
31000	68	16.468	7.841
33000	78	17.315	7.452
35000	70	14.522	7.731
37000	25	16.266	7.382
39000	4	19.366	6.910
41000	13	16.096	10.795
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	392		

Table 28: Statistics on Aircraft Encounters by Altitude for Hour 5

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	0	0.000	0.000
5000	1	11.731	0.000
6000	0	0.000	0.000
7000	1	16.243	0.000
8000	0	0.000	0.000
9000	0	0.000	0.000
10000	0	0.000	0.000
11000	0	0.000	0.000
12000	0	0.000	0.000
13000	0	0.000	0.000
14000	0	0.000	0.000
15000	0	0.000	0.000
16000	1	0.934	0.000
17000	1	25.102	0.000
18000	1	5.017	0.000
19000	1	14.349	0.000
20000	0	0.000	0.000
21000	3	17.436	5.191
22000	0	0.000	0.000
23000	1	17.681	0.000
24000	1	24.767	0.000
25000	1	28.146	0.000
26000	3	5.133	3.650
27000	0	0.000	0.000
28000	3	20.479	5.319
29000	2	21.625	8.189
31000	5	20.083	4.160
33000	8	18.610	8.583
35000	2	7.504	2.391
37000	1	16.935	0.000
39000	0	0.000	0.000
41000	0	0.000	0.000
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	36		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 29: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	21	146.175	34.695
2000	126	176.362	49.593
3000	325	185.811	53.387
4000	467	181.264	47.352
5000	544	180.702	53.959
6000	571	184.927	47.154
7000	604	195.814	45.580
8000	683	201.216	50.604
9000	683	207.603	57.381
10000	679	246.285	69.373
11000	666	250.988	68.583
12000	656	268.427	70.178
13000	650	269.295	68.200
14000	643	263.301	72.743
15000	645	276.391	67.970
16000	632	271.362	70.532
17000	621	278.822	68.533
18000	593	283.980	84.185
19000	570	296.941	80.138
20000	554	293.739	79.098
21000	530	321.543	66.233
22000	511	333.086	87.017
23000	497	361.386	80.232
24000	490	355.809	87.749
25000	495	368.714	87.517
26000	498	368.116	91.249
27000	485	405.570	81.736
28000	504	415.933	56.989
29000	500	450.988	67.260
31000	498	417.411	40.921
33000	432	469.463	45.468
35000	337	395.822	37.988
37000	215	460.817	55.070
39000	121	400.037	48.674
41000	69	444.107	71.135
43000	26	415.765	46.595
45000	6	421.280	41.842

Table 30: Statistics on Ground Speed by Altitude for Hour 1

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	144.706	23.727
2000	25	194.819	58.792
3000	73	197.670	51.271
4000	98	184.446	46.925
5000	112	181.077	56.031
6000	120	197.358	43.038
7000	126	188.416	39.914
8000	147	196.494	56.864
9000	141	216.998	58.445
10000	145	250.867	57.837
11000	142	251.778	62.737
12000	142	264.674	67.428
13000	141	262.231	65.955
14000	136	244.745	74.816
15000	137	266.771	62.561
16000	132	273.201	69.594
17000	128	273.928	72.766
18000	121	286.567	82.048
19000	109	328.384	84.847
20000	109	282.625	82.619
21000	108	311.779	66.585
22000	100	358.141	80.694
23000	95	362.794	79.487
24000	89	340.606	100.997
25000	89	351.309	101.942
26000	89	370.421	83.471
27000	87	440.459	75.248
28000	95	414.201	51.236
29000	91	456.145	61.579
31000	95	424.969	42.048
33000	83	474.709	57.953
35000	77	382.543	34.518
37000	43	433.159	71.612
39000	20	386.823	46.673
41000	10	374.427	110.760
43000	5	383.570	15.150
45000	3	396.548	18.570

Table 31: Statistics on Ground Speed by Altitude for Hour 2

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	7	131.639	39.103
2000	31	172.000	38.592
3000	89	185.900	52.476
4000	147	176.269	46.795
5000	173	174.485	48.522
6000	179	193.664	48.885
7000	194	198.561	46.541
8000	219	207.633	45.373
9000	206	207.724	56.556
10000	195	243.590	62.593
11000	184	262.605	64.723
12000	178	271.488	69.291
13000	177	263.406	70.162
14000	177	265.785	74.704
15000	179	279.264	74.761
16000	179	267.759	72.703
17000	176	297.914	72.486
18000	164	273.756	71.606
19000	159	294.332	73.089
20000	154	281.792	72.215
21000	143	325.189	77.243
22000	136	333.371	83.640
23000	127	387.625	69.490
24000	121	349.672	91.255
25000	122	361.883	83.120
26000	122	355.875	92.495
27000	119	404.902	89.861
28000	125	411.232	49.370
29000	126	433.059	77.579
31000	139	418.707	46.229
33000	138	466.379	41.949
35000	117	397.544	34.282
37000	67	446.804	53.074
39000	37	396.299	40.526
41000	25	404.805	77.009
43000	10	426.032	49.756
45000	3	403.452	21.171
Total	7	131.639	39.103

Table 32: Statistics on Ground Speed by Altitude for Hour 3

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	6	161.000	36.614
2000	35	172.417	52.212
3000	87	190.804	55.662
4000	134	185.365	48.273
5000	155	177.181	56.510
6000	158	183.157	44.392
7000	175	196.349	42.020
8000	194	199.303	51.810
9000	205	211.347	54.084
10000	199	257.289	75.124
11000	192	244.147	64.788
12000	184	261.519	70.718
13000	180	268.097	63.726
14000	180	264.715	66.107
15000	174	277.832	60.080
16000	173	268.626	67.580
17000	172	269.266	66.907
18000	160	308.904	78.309
19000	150	273.355	78.997
20000	150	297.642	76.290
21000	140	352.992	70.567
22000	142	365.351	74.062
23000	135	375.879	67.791
24000	134	366.596	75.025
25000	138	347.370	83.378
26000	138	358.394	100.265
27000	132	396.465	76.692
28000	146	401.250	74.249
29000	152	453.465	64.717
31000	162	415.713	38.633
33000	142	469.549	43.674
35000	118	402.672	34.136
37000	75	468.477	48.360
39000	40	398.373	39.097
41000	24	453.191	54.953
43000	8	424.355	38.883
45000	3	469.810	37.619

Table 33: Statistics on Ground Speed by Altitude for Hour 4

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	4	148.944	20.019
2000	28	177.482	35.814
3000	74	177.351	49.736
4000	99	177.929	45.154
5000	130	195.443	51.371
6000	139	174.771	47.168
7000	138	198.920	51.811
8000	148	197.379	47.669
9000	151	200.855	59.522
10000	153	236.390	71.953
11000	155	261.348	73.824
12000	157	271.943	71.065
13000	152	279.710	69.036
14000	150	274.492	71.127
15000	156	280.965	74.090
16000	147	273.368	72.880
17000	152	284.066	62.442
18000	145	269.531	96.006
19000	140	301.044	74.849
20000	133	332.575	75.881
21000	131	312.758	53.821
22000	128	306.811	88.498
23000	126	343.174	73.884
24000	128	352.876	84.166
25000	137	398.966	73.589
26000	144	392.810	74.733
27000	140	402.837	74.739
28000	155	427.447	44.111
29000	150	446.942	70.409
31000	167	415.475	39.921
33000	127	471.073	44.251
35000	98	396.472	40.377
37000	64	475.885	45.665
39000	45	418.598	50.894
41000	27	470.808	47.495
43000	6	389.062	51.526
45000	1	491.050	4.359

Table 34: Statistics on Ground Speed by Altitude for Hour 5

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	1	183.600	1.342
2000	11	149.984	55.046
3000	22	168.599	59.384
4000	31	190.378	53.556
5000	33	170.282	66.300
6000	42	165.313	46.841
7000	40	196.962	45.946
8000	39	206.438	51.840
9000	38	191.163	56.132
10000	37	241.883	89.125
11000	35	220.694	79.927
12000	32	295.852	75.125
13000	31	308.879	80.677
14000	33	303.186	75.841
15000	34	307.484	84.081
16000	36	287.362	66.092
17000	39	270.374	66.740
18000	34	310.487	102.470
19000	37	367.443	72.840
20000	36	290.996	94.733
21000	32	334.073	64.472
22000	32	293.508	92.021
23000	37	338.179	112.312
24000	41	398.100	77.989
25000	38	372.205	101.590
26000	37	347.416	111.659
27000	43	396.178	86.740
28000	48	436.196	47.569
29000	46	475.263	44.978
31000	44	416.817	38.232
33000	40	464.658	44.532
35000	45	395.465	56.496
37000	26	473.880	47.933
39000	19	391.164	94.935
41000	14	480.773	40.288
43000	2	428.778	26.197
45000	0	0.000	0.000

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 35: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	10	15
	DES	2	1
	LEV	11	13
2000	ASC	38	51
	DES	30	20
	LEV	55	64
3000	ASC	148	155
	DES	90	87
	LEV	169	127
4000	ASC	144	122
	DES	142	129
	LEV	287	157
5000	ASC	145	83
	DES	161	106
	LEV	344	138
6000	ASC	147	92
	DES	191	107
	LEV	372	111
7000	ASC	119	66
	DES	234	92
	LEV	364	82
8000	ASC	102	59
	DES	334	155
	LEV	359	71
9000	ASC	60	34
	DES	332	190
	LEV	353	63
10000	ASC	130	54
	DES	331	145
	LEV	354	78
11000	ASC	75	25
	DES	359	85
	LEV	351	56
12000	ASC	61	19
	DES	370	47
	LEV	353	36
13000	ASC	35	12
	DES	366	41
	LEV	346	30

14000	ASC	32	13
	DES	364	36
	LEV	345	32
15000	ASC	46	22
	DES	366	25
	LEV	345	33
16000	ASC	59	28
	DES	354	21
	LEV	343	27
17000	ASC	62	25
	DES	345	20
	LEV	330	29
18000	ASC	37	12
	DES	322	20
	LEV	320	30
19000	ASC	39	16
	DES	313	17
	LEV	313	27
20000	ASC	41	21
	DES	299	15
	LEV	295	33
21000	ASC	40	15
	DES	287	12
	LEV	291	36
22000	ASC	40	20
	DES	270	14
	LEV	274	38
23000	ASC	38	18
	DES	270	19
	LEV	265	38
24000	ASC	64	30
	DES	265	19
	LEV	252	32
25000	ASC	47	22
	DES	267	30
	LEV	260	46
26000	ASC	48	23
	DES	266	27
	LEV	268	49
27000	ASC	74	39
	DES	264	26
	LEV	267	41
28000	ASC	167	101
	DES	263	36

	LEV	279	54
29000	ASC	178	102
	DES	259	33
	LEV	270	47
31000	ASC	216	127
	DES	255	41
	LEV	279	51
33000	ASC	248	147
	DES	208	41
	LEV	231	35
35000	ASC	236	166
	DES	144	30
	LEV	157	35
37000	ASC	151	102
	DES	104	28
	LEV	85	18
39000	ASC	92	56
	DES	67	8
	LEV	41	7
41000	ASC	59	37
	DES	38	13
	LEV	26	8
43000	ASC	24	13
	DES	13	4
	LEV	8	2
45000	ASC	6	4
	DES	1	0
	LEV	1	1

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 36: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	137	9.121
B733	78	5.193
DC9Q	75	4.993
B752	55	3.662
SF34	54	3.595
BE20	53	3.529
B722	51	3.395
DC9	45	2.996
BE58	37	2.463
B72Q	33	2.197
CARJ	32	2.130
F100	30	1.997
B735	29	1.931
A320	27	1.798
B732	23	1.531
BE9L	22	1.465
E145	22	1.465
C560	21	1.398
C550	20	1.332
B190	19	1.265
LJ35	19	1.265
PA31	19	1.265
C650	17	1.132
B737	16	1.065
B73Q	16	1.065
A306	15	0.999
C210	15	0.999
H25B	14	0.932
E120	13	0.866
B763	12	0.799
LJ31	12	0.799
B734	11	0.732
BE36	11	0.732
BE40	11	0.732
BE55	10	0.666
DC10	10	0.666
BA46	9	0.599
JS32	9	0.599
JS41	9	0.599

C182	7	0.466
C208	7	0.466
C421	7	0.466
C441	7	0.466
C525	7	0.466
CL60	7	0.466
PA32	7	0.466
PAY2	7	0.466
AC90	6	0.399
DC87	6	0.399
FA20	6	0.399
H25A	6	0.399
PC12	6	0.399
BE35	5	0.333
BE90	5	0.333
DC86	5	0.333
FA10	5	0.333
FA50	5	0.333
GLF2	5	0.333
GLF4	5	0.333
HS25	5	0.333
LJ24	5	0.333
LJ25	5	0.333
PA46	5	0.333
SW4	5	0.333
WW24	5	0.333
AT45	4	0.266
B762	4	0.266
BE10	4	0.266
BE18	4	0.266
BE33	4	0.266
C340	4	0.266
C414	4	0.266
C500	4	0.266
L101	4	0.266
P28R	4	0.266
P32R	4	0.266
PA34	4	0.266
PAY1	4	0.266
SBR1	4	0.266
SW3	4	0.266
A310	3	0.200
AC95	3	0.200
AEST	3	0.200
ASTR	3	0.200

AT72	3	0.200
BE9T	3	0.200
C141	3	0.200
C172	3	0.200
DC8Q	3	0.200
LJ55	3	0.200
LR25	3	0.200
AC11	2	0.133
AC50	2	0.133
AC6T	2	0.133
AT43	2	0.133
B721	2	0.133
B738	2	0.133
BE99	2	0.133
CL65	2	0.133
F2TH	2	0.133
F900	2	0.133
GLF3	2	0.133
H25C	2	0.133
H60	2	0.133
JS31	2	0.133
LJ23	2	0.133
LJ60	2	0.133
LR35	2	0.133
M20	2	0.133
MD11	2	0.133
MD90	2	0.133
MU2B	2	0.133
P28A	2	0.133
P3	2	0.133
PA27	2	0.133
PA28	2	0.133
SH33	2	0.133
T2	2	0.133
747	1	0.067
A10	1	0.067
A300	1	0.067
AT38	1	0.067
B20	1	0.067
B350	1	0.067
B52	1	0.067
B73B	1	0.067
B742	1	0.067
BE65	1	0.067
BE76	1	0.067

BE95	1	0.067
BL17	1	0.067
C17	1	0.067
C177	1	0.067
C425	1	0.067
C82R	1	0.067
CL41	1	0.067
CVLP	1	0.067
DA20	1	0.067
DC8	1	0.067
DC85	1	0.067
F16	1	0.067
G159	1	0.067
G2	1	0.067
G4	1	0.067
GC1	1	0.067
GLF5	1	0.067
LJ45	1	0.067
LR60	1	0.067
M20P	1	0.067
M20T	1	0.067
MO20	1	0.067
MU3	1	0.067
MU30	1	0.067
MXT7	1	0.067
P180	1	0.067
P210	1	0.067
P28B	1	0.067
P31T	1	0.067
PA23	1	0.067
PA24	1	0.067
PAY4	1	0.067
SW2	1	0.067
T37	1	0.067
TRIN	1	0.067
Total	1502	100.000